Achievements and Ambitions: an Overview of the Current European Project Landscape

François Bodin

Jean-François Lavignon

EXDCI2

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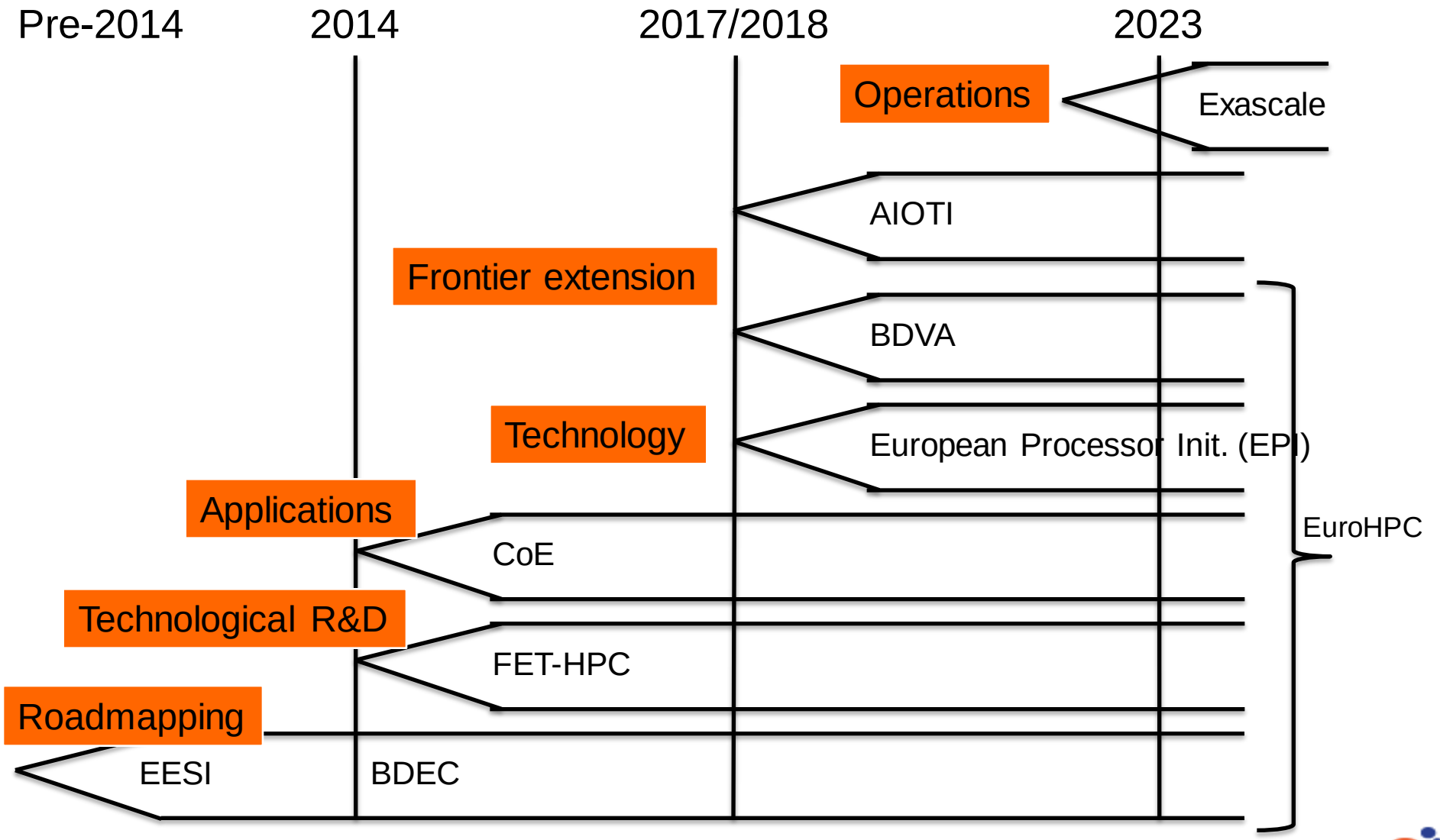
Introduction

- EU is committed to develop the next generation of HPC systems and applications
  - “systems 50x to 100x faster than 2017 on real apps” in 2023

- In a context of HPC frontier extensions
  - Discovery process
    - Data oriented approach
    - Digital twins
  - Spatial
    - The Exascale
    - The Edge, the Fog
  - Technological
    - Software: new hourglass model, workflows, containers
    - Hardware (e.g. NVM, photonics, Percipient storage, ...)

EU Initiatives



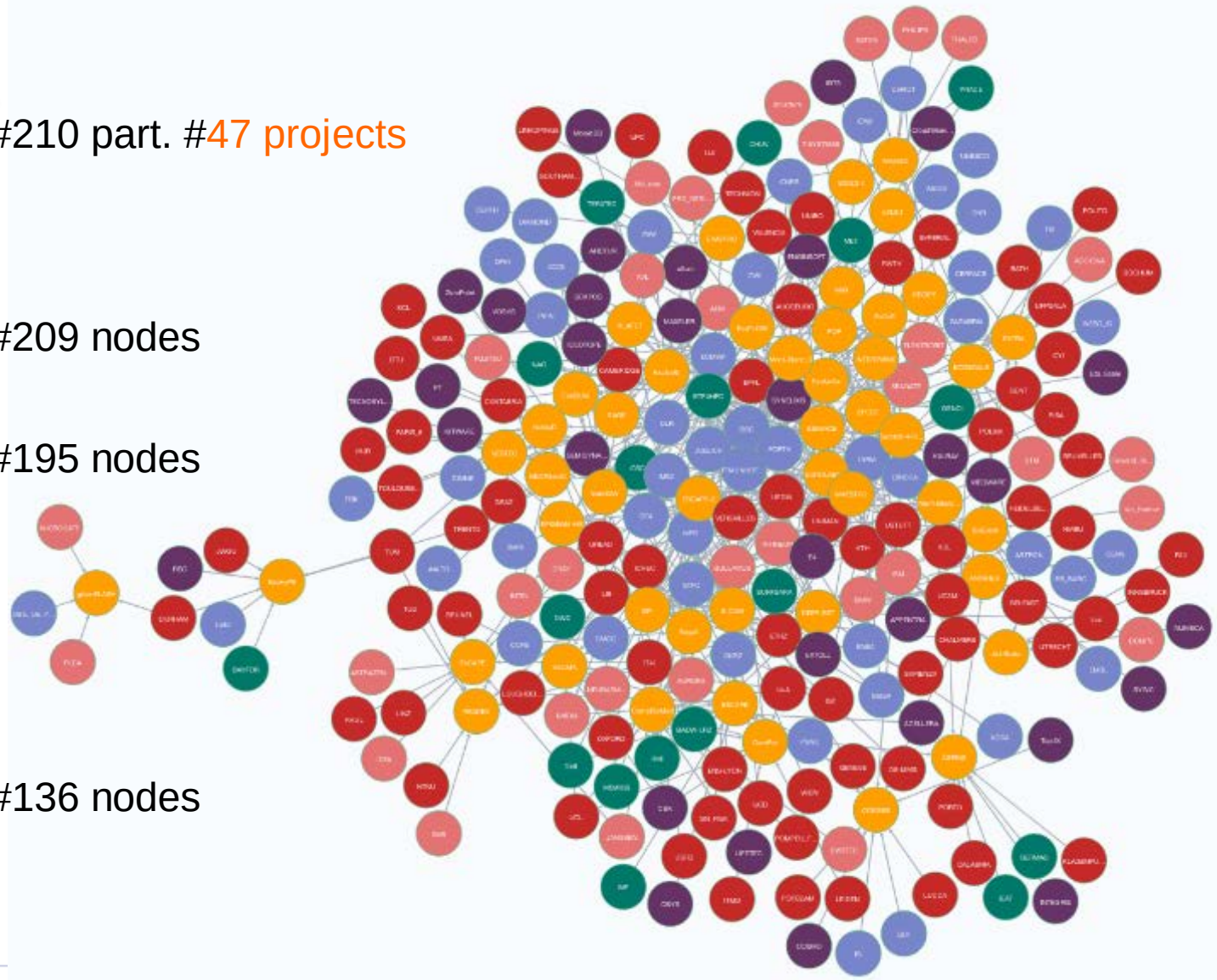
FET-HPC Projects Growth (**Projects** and Members)

2017 - #210 part. #47 projects

2016 - #209 nodes

2015 - #195 nodes

2014 - #136 nodes



2014 European FET-HPC Projects & Results

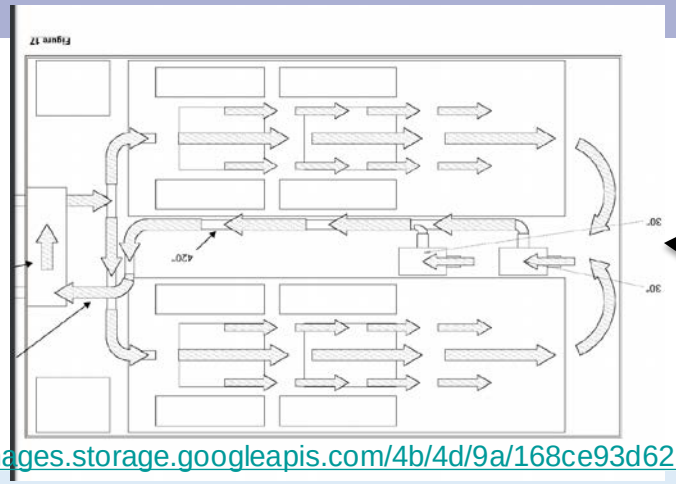
HPC System Oriented Projects

- From silicon package to system
  - Interposer, UNIMEN architecture, interconnect, software stack
- ARM-based HPC
  - Demonstrator and software stack
- Reconfigurable compute
  - Architecture, programming environment
  - Time constraint architecture
- IO
  - New memory hierarchy
  - File system

HPC Stack and Application Oriented Projects

- Energy efficiency
  - Metric, DSL, autotuning
- Programming models
  - OmpSs, StarPU, GASPI, PaRSEC, MPI, OpenMP
  - C++ templates + tool chain
- Deployment of multiscale applications
- Generic applications
  - Hyperbolic PDE
  - Fluid dynamics
  - Machine learning (for drug discovery)
  - Numerical linear algebra
  - Weather models

Results of the Projects (1)



https://patentimages.storage.googleapis.com/4b/4d/9a/168ce93d621ce1/WO2018096362A1.pdf

Iceotope have filed 10 patents within the FETHPC project, 8 in ExaNeSt and 2 in EuroEXA

Type of result	Number per type of result
API	4
application optimisation	5
benchmark suite	5
demonstrator	8
hardware	20
report	2
software	88
training	6
Total	**138**

hardware	20
accelerator	1
board with FPGA	3
computing module	1
computing node	2
cooling	2
DMA	1
HPC system	2
interconnect	4
processor	1
rack switch	1
technology	1
scheduler implemented in hardware	1

Results of the Projects (2)

Type of result	Number per type of result
API	4
application optimisation	5
benchmark suite	5
demonstrator	8
hardware	20
report	2
software	88
training	6
Total	**138**

software	**88**
API	2
API for RDMA	1
API for reconfiguration of FPGA	1
application	25
application library	1
application middleware	5
Application optimization	4
CAD tool	1
communication library	4
Compiler	2
data base	1
debugging module	1
file system	2
firmware	1
FPGA tool	1
IO stack	1
library system	2
optimization on FPGA	1
optimization tools	1
OS	1
performance model	1
programming environment	1
programming environment for FPGA	1
runtime	8
simulator	2
software stack	1
system middleware	4
system software	5
tools	5
VHDL IP	1
programming model	1

Demonstrators Developed by the Projects (1)

- Exanode-ExaNeST-EcoScale
  - Based on ExaNest daughter board
  - ~20 boards

- MANGO
  - 8 HPC servers and 196 FPGA

- DEEP
  - Modular Supercomputing concept developed in the DEEP projects is **now also used in production machines at JSC**

- Greenflash
  - To demonstrate control of telescope mirrors

Demonstrators Developed by the Projects (2)

- SAGE
  - Open to test; 4 tiers of storage

- NextGenIO
  - based on DC Persistent Memory™,

    next-generation non-volatile memory technology

First commercial system acquired by CEA

- Mont-Blanc
  - Open to test; Dibona 96 sockets

    ARM ThunderX2

Conclusion

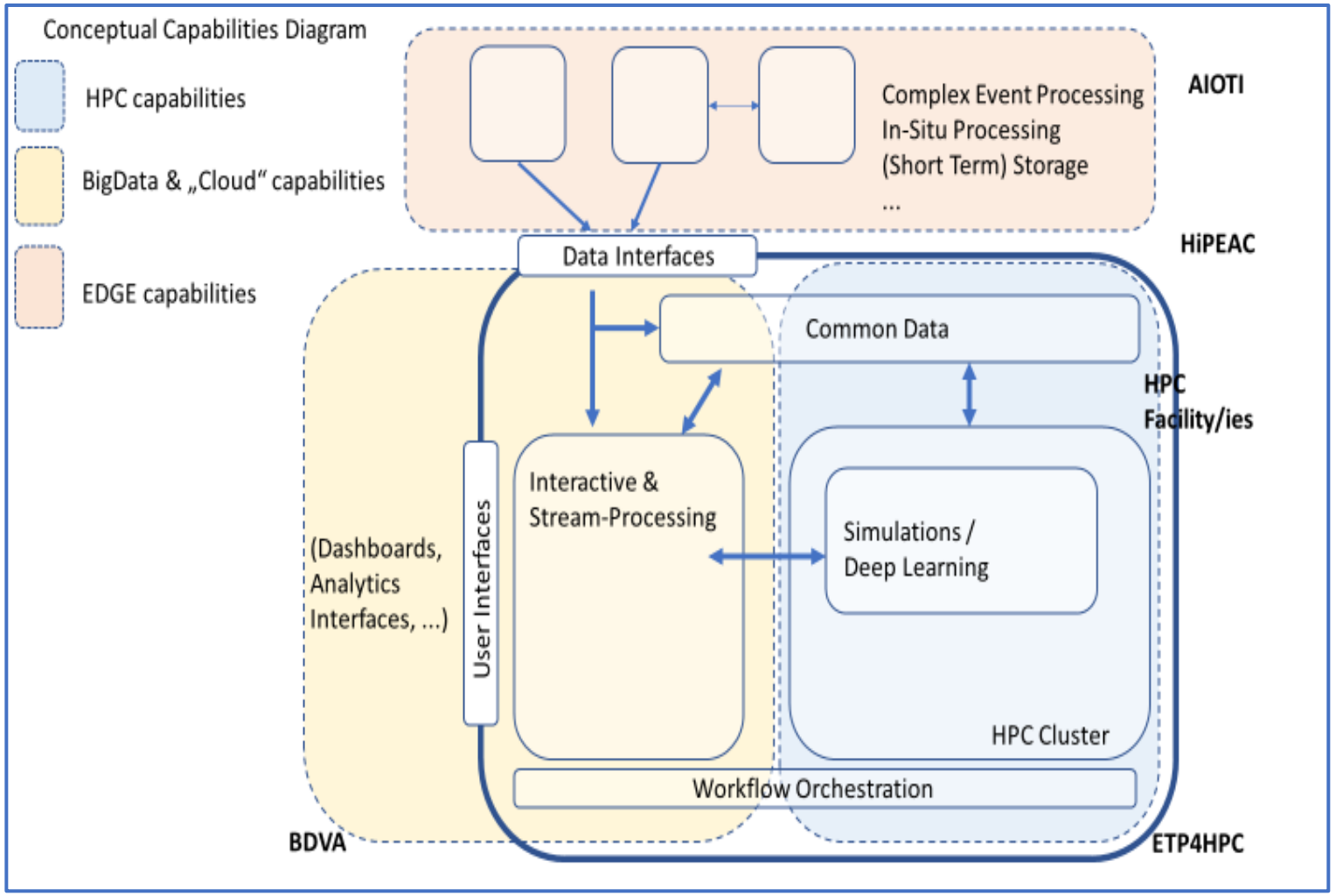
- The European organization landscape is evolving profoundly
  - EuroHPC joint undertaking
  - European Open Science Cloud
  - European Processor Initiative

- To address many challenges
  - **More technology developments in Europe**
  - Creating synergies between HPC/HPDA/IoT
  - Exascale applications able to address our societal challenges

FET Project Results Mapping

Techno Targeted user	Computing node/board	Interconnect/ Memory hierarchy	Storage/file system	Tools for FPGA	Software stack	Programming model/ tool	Optimization tools	Library	Application
ESD	Ecoscale Exanode MontBlanc3	NextGenIO ExaNest Ecoscale	SAGE	MANGO EXTRA	Greenflash EcoScale	Exanode InterTwine	Ecoscale		
HPC system provider	Greenflash ExaNest Ecoscale MontBlanc3 Exanode	NextGenIO ExaNest	SAGE	MANGO Ecoscale	MANGO Greenflash MontBlanc3	AllScale InterTwine			NextGenIO COMPAT
Computing centre			SAGE		MANGO NextGenIO MontBlanc3 COMPAT	InterTwine			NextGenIO COMPAT
Application developer			ExaNest SAGE NextGenIO	MANGO Ecoscale EXTRA		MANGO AllScale Greenflash MontBlanc3 Exanode InterTwine	Greenflash MontBlanc3 EXTRA	ExaFlow ExCAPE NLAFET	
End user						ExaFlow	NLAFET	NLAFET	ExaNext ExaFlow ESCAPE ExHype ExCAPE NLAFET

Frontier Extension, an Example the Digital Twins



Src: Jens Krueger ITWM Faunhofer, BDVA/ETP4HPC/EXDCI2